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INSECTS ATTACKING VEGETABLES IN PORTO RICO.

By R. T. Cotton, Former Entomologist, Insular Experiment Station.

The growing of vegetable crops in Porto Rico is attended by a great many difficulties, not the least of which is that due to the ravages of insects.

Vegetable crops are peculiarly susceptible to insect attacks, more so than the majority of other crops, and it has been estimated that a loss of no less than 20 per cent of the total value of the crop is caused by their ravages.

In order to successfully fight these pests and so reduce this loss it is necessary to know something of the nature of these insects, their intimate life histories, and their methods of attack. It is with the object of presenting the more important facts about these insects, together with the best known methods of combating them, that this article has been prepared.

Much of the material for this paper has been taken from the experiments and notes of this station, and is here presented for the first time, although information has been freely taken from the various standard works on insects injurious to vegetables, and from publications of various Experiment Stations and of the United States Bureau of Entomology.

ACKNOWLEDGMENTS.

Many thanks are due to Dr. L. O. Howard for his kindness in permitting the use of many of the illustrations that appear in this text, and which originally appeared in publications of the U. S. Bureau of Entomology. We are also indebted to him for the determinations of many of the insects discussed in the following pages. Credit is due to Mr. Eugene G. Smyth for many of the photographs from which illustrations have been made.

GENERAL CONSIDERATIONS.

Before taking up a discussion of any one particular insect in its relation to vegetables it would be well to consider the subject of insects in general, their differences in structure and habits, and the significance of these factors with regard to the methods employed to control them.

Insects may be roughly divided into two general classes, those possessing biting mouthparts and those with sucking mouthparts. To the first class belong grasshoppers, leaf-feeding beetles, and caterpillars. To the second, such insects as plant lice, scale-insects, bees, and true bugs. Insects of the first class may usually be destroyed by the use of stomach poisons, but this form of control is useless for the second class, which must be hit by a contact spray in order to be killed.

Most insects pass through a number of different changes in form before becoming adults. Some such as the grasshoppers and true bugs have what is known as an incomplete metamorphosis. They hatch from the egg into forms resembling the adults, but differing usually in size and in lacking certain organs such as wings. This stage between the egg and adult is known as the nymphal stage. Other insects such as the butterfly, beetle, and bee have what is known as a complete metamorphosis. On leaving the egg they assume a form entirely different from the adult. This is the larval or grub stage, an active feeding stage. After this stage they change to a pupal or resting stage, and finally to the adult forms.

These stages differ remarkably in form and habit in the different species of insects. Some are passed in the soil, others in the air, some on the foliage of plants, and some within the stems and tissues of the host plant itself.

A careful study of all stages in the life of an insect will usually reveal a weak spot, and advantage may be taken of this in controlling the pest.

CONTROL MEASURES.

Control measures are numerous and varied, but may be all roughly classified under the two main groups, direct and indirect.

Indirect measures are mostly preventive and consist of any practice that does away with conditions favorable to injurious insect life. Clean cultivation, the destruction of weeds and trash that harbor destructive insects, the intelligent rotation of crops, the planting of clean seed, the use of hardy seedlings, the proper use of

fertilizers, the use of trap crops, and the protection of the natural enemies of insect pests all have their uses in reducing the loss caused by insects, and often constitute the most effective means of keeping some of the worst pests under control.

Direct measures are those that kill by mechanical methods, stomach poisons, contact sprays, or fumigation.

MECHANICAL METHODS.

Under this head comes the practice of collecting insects in order to destroy them. This may be done by hand-picking, sweeping them into nets, catching them on various kinds of sticky surfaces, or by catching them with trap lights. Many types of insects may be controlled by these methods when no other way is feasible.

STOMACH POISONS.

The best known and most commonly used stomach poisons in insect control are the various arsenical compounds. The most effective of these are discussed below.

Arsenate of Lead.—This is an excellent poison, and is used more extensively than any other arsenical in the control of leaf-eating insects. It may be used either as a liquid spray or in the form of dust and is effective both ways. For most leaf-eating insects it is usually used at the rate of one pound of the powder form, or two to three pounds of the paste to one hundred gallons of water. Applied in dust form it is very effective and is peculiarly adapted to Porto Rican conditions. It should be mixed with an equal part of air-slacked lime, or dry, leached wood ashes, and may be applied by shaking from a cheese-cloth bag, or by the use of a dust gun.

Paris Green.—This is probably the best known of the arsenicals used in insect control, and it is a very strong and deadly poison. It is excellent for use in the preparation of poison baits, but owing to its tendency to burn delicate foliage, it is being displaced as a leaf spray, by the newer and safer arsenicals.

Two other arsenicals that are coming into favor and are giving excellent results in insect control are calcium arsenite and zinc arsenite. These both come in the same form as arsenate of lead, and may be used in a similar manner.

CONTACT INSECTICIDES.

The various concoctions of kerosene, tobacco, and soap are the standard contact sprays and may be used against all soft-bodied sucking insects.

Kerosene emulsion, when properly made and applied, is one of the best of these and may be used against the hardier insects. When used on tender plants there is some danger of burning the foliage unless great care it taken in the preparation and dilution of the stock. The formula and directions for making the stock solution are as follows:

Kerosene	2	gallons.
Soap	½	pound.
Water	1.	gallon.

Dissolve the soap in boiling water and pour while boiling into the kerosene. This mixture should be emulsified quickly by pumping it back into itself with a force pump for about five minutes. Properly prepared it should have the consistency of thick cream and should hold up indefinitely.

For ordinary use on vegetable crops this stock solution should be diluted at the rate of one part of stock to fifteen parts of water.

Tobacco.—Tobacco is used in several different forms against soft-bodied insects, as a dust, as a liquid spray, and as a fumigant.

Nicotine sulphate is the most effective of these tobacco extracts and, owing to its good qualities and ease of preparation, is taking the place of kerosene emulsion in the control of a great many of the soft-bodied insects. It is a standard solution containing 40 per cent by weight of nicotine, and is sold under a trade name. It is usually used at the rate of one part of stock to a thousand parts of water, with soap added at the rate of three pounds to fifty gallons of spray.

Tobacco concoction.—This is a somewhat weaker tobacco solution, but is quite effective in the control of plant lice. It is made by boiling tobacco stems, leaves or refuse in water at the rate of one pound to one gallon of water. This stock solution may be diluted slightly according to the resistance of the insect it is used against.

Tobacco papers.—These are made by soaking strips of paper in tobacco extract. In the control of plant lice on melons and similar plants, these are sometimes burned under frames thrown over the plants, the fumes given off killing the lice.

Soap.—Any good soap may be used as a wash for controlling plant lice and other soft-bodied insects. It is not so effective, however, as kerosene emulsion or the combination of tobacco extract and soap, but may be used when other materials are not available. Fish-oil soap is cheap and is one of the best to use. This and other soaps should be used at the rate of one pound to six or eight gallons of water.

STICKERS AND SPREADERS.

Some plants have a waxy or very smooth foliage to which the ordinary spray does not readily adhere. To remedy this it is necessary to add to the spray a so-called sticker or spreader. The following are a few of the best of these:

Ordinary soap added at the rate of one pound to five gallons of the spray is effective in making it stick better.

Two pounds of resin and one pound of sal soda (crystals) boiled for an hour in a gallon of water make an excellent compound for the purpose. This amount is sufficient for forty gallons of spray.

GENERAL FEEDERS.

There are a great many insects that do not confine their attacks to one particular crop, but feed on practically all vegetables indiscriminately. These are known as general feeders and are treated separately as follows:

ANTS.

Ants, which are so well known to everyone, are occasionally troublesome in the garden. They are very fond of some kinds of seeds, and will often eat the entire soft part of the seed, leaving nothing but the empty shell. At other times they will carry off the seeds bodily to their nests, where they later devour them.

The "fire ant" (*Solenopsis geminata*) occasionally feeds on the stems and fruits of some vegetables, building runways of earth over both stems and fruit.

Indirectly they cause further damage by starting colonies of plant lice on the various vegetable crops, taking care of them and moving them from plant to plant in return for a sweetish substance secreted by the lice.

Control.—The most effective method of controlling these pests is to destroy their nests. This may be accomplished by pouring a little carbon bisulphide into the nest, and then packing the earth down over the entrance holes so that the evaporating carbon bisulphide will not escape into the air, but will spread through the soil and kill the ants. Another method is to spray the nests thoroughly with an emulsion of carbolic acid and soap. This spraying should be repeated the following day to insure the destruction of all the ants. The emulsion may be made as follows:

Water	1	quart.
Soap	½	pound.
Carbolic acid (crude)	1	pint.

Dissolve the soap in the water, then add the crude carbolic. Finally add enough water to make two quarts of solution. For use, this stock solution should be diluted at the rate of one pint of stock to six gallons of water.

THE CHANGA.

The changa or mole cricket, *Scapteriscus vicinus,* attacks a majority of the vegetables grown in Porto Rico, and is especially destructive in the sandy-loam soils of the coastal regions.

These rather ferocious looking insects (Fig. 24), with their fore legs peculiarly adapted for digging and excavating, make galleries or runways just beneath the surface of the soil, where hidden from sight they can travel in safety from one plant to another. They feed chiely on the roots of living plants, and the stems and foliage of young seedlings that have just been set out in the field. They feed usually at night and are frequently to be seen around the houses in the evenings, where they have been attracted by the lights.

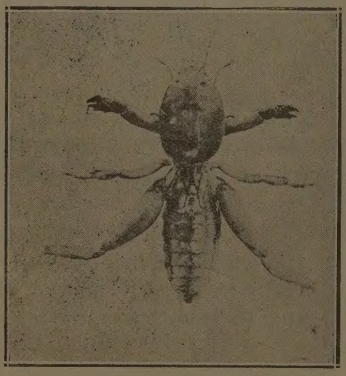

FIG. 24.—The Changa (*Scapteriscus vicinus*). Adult.

Control.—Fortunately these insects are readily controlled by the use of a poison bait,[1] made as follows:

	Pounds.
Flour (low grade)	100
Paris green	3

Mix these two ingredients thoroughly, and broadcast the resulting mixture over the prepared ground about a week before the vegetables are planted or protect each individual plant by placing about a spoonfull of the mixture in a shallow trench around the plant. Either of these methods will prove very effective in controlling the changa.

CRICKETS.

The so-called "sick cricket," *Amphiacusta caribbea,* is another insect that feeds indiscriminately on vegetable crops. It is nocturnal in habit, hiding during the day under trash or in craks in the soil,

[1] S. S. Crossman and G. N. Wolcott, Circ. No. 6, Board of Comm. of Agric. of P. R. (Insular Exp. Sta.)

and coming out at night to feed. It often occurs in great numbers and at these times is very destructive.

Control. It may be very effectively controlled by the use of a poison bait as described for use against grasshoppers.

FIG. 25.—Cricket (*Amphiacusta caribbea*). Adult.

CUTWORMS.

These inconspicuously colored caterpillars are the immature forms of a large family of moths called the Noctuids. They are usually somewhat brownish in color, mottled with markings of gray, yellow, or black. They are naked or only sparsely clothed with hairs, and vary in length from one to two inches when full grown.

They feed chiefly during the night, hiding during the day beneath clumps of earth or in cracks in the soil, their inconspicuous colors blending so well with the soil that it is difficult to see them.

FIG. 26.—Cutworm. A larva boring into a bean pod.

They often cause great damage by feeding on the foliage of young plants, and cutting them off just as the young plants are pushing through the ground. Hence their name of "cutworms."

Control.—These cutworms are generally kept pretty well under control by their natural enemies. They are preyed upon by lizards, birds, spiders, ground beetles, Tachinid flies, and Hymenopterous parasites.

When they become very numerous, however, they may be controlled by the use of a poison bait, as recommended for the grasshoppers (Page 272). This bait should be scattered over the soil around the plants in the early evening.

FLEA-BEETLES.

The flea-beetles, so called from their habit of jumping suddenly from one plant to another when disturbed, are small leaf-eating beetles belonging to the family *Chrysomelidæ*.

Some of them are more or less general feeders and cause great damage by riddling the leaves with their feeding punctures.

The worst of these is the so-called "pulga americana," *Systena basalis,* which feeds indiscriminately on nearly all vegetable crops. The larva of this beetle feeds on the roots of weeds and some cultivated plants, but does not cause a great deal of damage.

In addition to the direct injury caused by feeding, the flea-beetles undoubtedly transmit diseases from one plant to another.

Control.—Excellent results may be obtained by keeping the plants dusted with a mixture of equal parts of arsenate of lead and hydrated or air-slacked lime or dry, leached, wood-ashes. Two applications a week when the beetles are numerous will effectively control them.

GRASSHOPPERS.

FIG. 27.—Grasshopper. Adult.

There are some three or four species of grasshoppers that are occasionally to be found doing damage in the garden. They feed indiscriminately on the tender truck crops, but are rarely numerous enough to cause any serious damage.

Control.—Lizards and birds to a great extent keep these pests from becoming numerous enough to do much damage. When they do appear in destructive numbers, they may be effectively controlled by the use of a poison mash. The formula and directions for making it follow:

Bran or corn meal	25 pounds.
Paris green or white arsenic	1 pound.
Molasses (low grade)	3 pints.
Oranges	6

The bran or meal should be mixed with the molasses and the sliced oranges, and enough water to make the whole mixture moist. The paris green or white arsenic should then be added and stirred in well.

This bait should be scattered broadcast through the infested field in the early evening. It should not be distributed during the day as the heat of the sun would soon dry it up, and it would lose most of its effectiveness.

LEAFHOPPERS.

Leafhoppers are usually quite abundant in the garden and often do a great deal of damage. They are delicate little insects with long

hind legs specially fitted for jumping. As soon as the vegetation on which they are feeding is disturbed they hop into the air in small clouds, and fly off to nearby plants.

They cause damage by sucking the plant juices from the foliage, thus sapping the vitality of the plant and often causing the leaves to curl and dry up. They attack a great variety of vegetables, and although most of them prefer one particular plant, some of them will attack a great number. This is particularly true of the apple leafhopper, *Empoasca mali*, but this pest will be discussed in greater detail as a pest of the bean.

FIG. 28.—Nematodes (*Heterodera radicicola*). Showing the nodules produced on celery roots.

Control.—Leafhoppers being sucking insects cannot be poisoned, but must be hit with a contact spray in order to kill them. A soap and nicotine sulphate spray as described on page 268 is effective in killing a large number of them if properly applied. The spray should be applied as fine as possible and to the undersides of the leaves. Sticky surfaces may also be used very effectively in catching the hoppers. These should be carried along the rows of plants, and the hoppers caught as they fly up on being disturbed.

NEMATODES.

A great many of the vegetable crops are attacked to a greater or less extent by a minute thread-like worm, *Heterodera radicicola*, which bores into the roots, causing them to swell, and stunting or stopping the growth of the plant. Fig. 28 shows the work of this worm or nematode on the roots of celery.

Control.—Ground that is known to be infested with these worms should be planted only to crops that are resistant or immune to their attacks. Seedlings should be grown in sterilized seed-beds. Infested land may be treated with applications of wood ashes, lime, or salt to reduce the number of nematodes or with Cyanamid [1] at the rate of from one to three tons per acre.

SLUGS OR LAPAS.[2]

Fig. 29.—Slug.

These slimy, repulsive looking creatures are very destructive to all green crops, and occasionally do great damage to some vegetables. They are nocturnal in habit, hiding during the day and coming out to feed at night. It is usual during a season of heavy rains for them to occur in destructive numbers.

Control.—The lapas may be cleared from a field by collecting them at night with the aid of lanterns. They may also be controlled by placing fresh-cut leaves between the rows of plants in the evening, and collecting in the morning the lapas that have crawled under them. A light application of lime on the soil around the plants is also effective in protecting them from the lapas.

WHITE GRUBS.

There are several species of white grubs that do damage to our truck crops. These grubs are the immature forms of the large brown beetles known as "May beetles" or "June bugs." They are large, fleshy, wrinkled, white grubs, that lie curled in a semi-circle

[1] Watson, J. R., Florida Agric. Exp. Sta. Bul. 136.
[2] *Veronicella occidentalis.*

in the soil around the roots of a great variety of plants. Although provided with three pairs of legs, they are not able to walk. The head is light brown in color, and has well developed mouthparts.

These white grubs have a life cycle of about one year in duration. The eggs are laid in the soil and hatch in about two weeks. The grub stage then lasts for a period varying from six to twelve months. It is during this larval or grub stage that the damage is done to the vegetable crops, the grubs trimming off the tender young roots and girdling the larger ones so that the affected plant soon dies. When full grown the grub changes to the pupal or resting stage which lasts for about a month. Then it changes to the adult beetle which emerges from the soil to mate and feed.

FIG. 30.—May-Beetle (*Phyllophaga* sp.). Adult.

Control.—It is very difficult to control these pests, and no very satisfactory or practical methods have as yet been discovered for entirely getting rid of them.

In general, crop rotation should be practiced, the grubs should be collected by hand when the land is plowed, and when possible, land known to be infested with the grubs should not be planted to vegetable crops.

BEANS.

BEAN LEAF-BEETLE (*Cerotoma ruficornis*).

Of considerable importance to bean growers is the bean leaf-beetle (Fig. 32). It is a small, reddish-brown beetle with black

markings, and usually becomes very abundant wherever beans are grown.

Feeding on the leaves, the beetles when abundant strip them to the veins and mid-ribs, causing great damage. They deposit their yellowish-colored eggs in the soil around the roots of the plant. These hatch in a few days and the whitish larvæ that emerge feed on the roots and nodules of the bean, causing additional damage.

Control.—If, when the beetles first begin to appear, the plants are thoroughly sprayed with arsenate of lead, three pounds in fifty gallons of water, little trouble will be experienced from them.

BEAN LEAF-HOPPER (*Empoasca mali*).

FIG. 31.—White Grub (*Phyllophaga* sp.). Larva.

This leaf-hopper, known in the United States as the apple leaf-hopper, is always in great abundance in the garden. It attacks a great variety of plants, but its greatest damage is done to the bean.

The leaves of the bean are curled and distorted, and the edges turn yellow and dry up. This is caused by the sucking of the juices from the tissues, and results in a serious stunting of the plants and a consequent decrease in the yield.

The hopper itself is a small, delicate, green insect with a life cycle of a little less than three weeks. This short life cycle makes it possible to increase in numbers with extreme rapidity.

Control.—This insect is attacked by a fungus, *Sporotrichum globuliferum,* which helps somewhat to keep it in check. The methods given for controlling leaf-hoppers in general (page 273) may be used on this insect with good results.

BEAN LEAF-MINER (*Agromyza jucinda*).

The leaves of the bean are occasionally mined by the grub of a small Agromyzid fly, but it is parasitized so heavily that it never causes an appreciable amount of damage, and no control measures are required.

BEAN LEAF-ROLLER (*Eudamus proteus*).

The larva of this swallow-tailed skipper, known as the bean leaf-roller, is usually to be found feeding on the leaves of the bean.

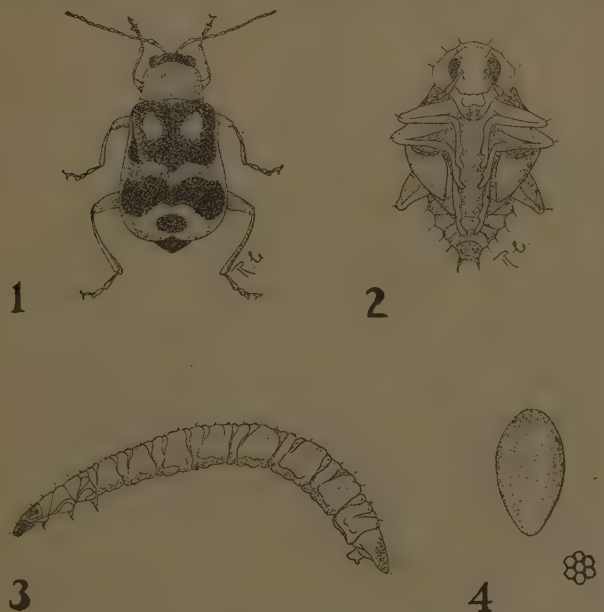

FIG. 32.—Bean Leaf-Beetle (*Cerotoma ruficornis*). 1, adult; 2, pupa; 3, full-grown larva; 4, eggs. All much enlarged.

Forming a characteristic shelter by rolling up the edges of the leaf, the larva hides within, coming out at times to feed on the foliage immediately around it.

The handsome green larva is readily distinguished from other pests of the bean by the narrow constricted neck that joins the prominent brown head to the velvety green body.

The bluish-green adult known as a skipper butterfly may be seen darting rapidly here and there among the bean plants, occa-

sionally stopping to deposit eggs on the foliage, or to feed upon the nectar of the flowers. These eggs soon hatch, and the larvæ feed upon the foliage for a period of about two weeks, after which they change to pupæ and later to adults.

Control.—This pest never becomes excessively abundant owing to the good work of a small hymenopterous insect that parasitizes the larvæ. When troublesome, however, it may be readily controlled by spraying the affected plants with an arsenate of lead spray, at the rate of one and a half pounds of arsenate of lead to fifty gallons of water.

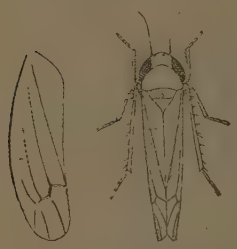

FIG. 33.—Bean Leaf-Hopper (*Empoasca mali*). Adult and enlarged wing. (U. S. Bureau of Entomology.)

BEAN LEAF-WEBBER (*Nacoleia indicata*).

The larva of this small pyralid moth is always more or less abundant on the foliage of the bean. The small dirty-green colored larva webs the leaves together, living between them and skeletonizing them with its feeding. It has a very short life cycle and multiplies rapidly.

FIG. 34.—Bean Leaf-Webber (*Nacoleia indicata*). Male moth. Enlarged. (U. S. Bureau of Entomology.)

The adult moth is golden yellow in color, the two pairs of wings being marked with several transverse, dark, wavy lines.

Control.—This pest may be controlled by spraying the leaves with an arsenate of lead spray, two pounds of the poison to fifty gallons of water.

BEAN POD-BORER (*Maruca testulalis*)

The pinkish-white larva of this moth is frequently served on the table with string beans. It has the habit of boring into the green pods, and while not generally abundant is occasionally troublesome.

The adult is a very handsome pyralid moth, front wings a dark, almost golden brown with a large irregular white mark and two smaller ones, hind wings silvery white, bordered on the outer margin with an irregular, brown patch.

Control.—Infested pods should be collected and destroyed. An arsenate of lead spray as recommended for the preceding species, would kill a great many of the larvæ before they could eat their way into the pods.

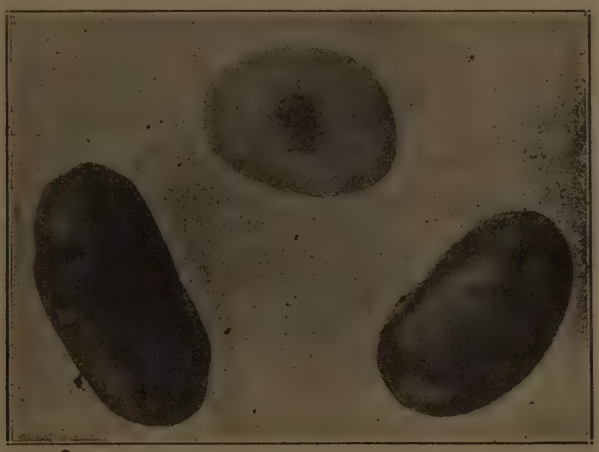

FIG. 35.—Bean Weevil (*Bruchus obtectus*). Showing nature of injury and adult weevil.

BEAN WEEVILS.

Several species of weevils attack beans and cowpeas destroying the seeds. The commonest of these are *Bruchus obtectus* and *Bruchus quadrimaculata.*

These weevils begin their depredations in the field, but the greatest injury occurs after the beans have been harvested and placed in storage. If the seed is not protected by fumigations, or by being kept in weevil-proof containers, they will be completely destroyed by the weevils, and in a very short space of time.

In the field the female weevils deposit eggs in small cavities eaten out of the pod. Small white grub-like larvæ hatch in a few days and complete their development within the seeds.

Practically nothing can be done to combat the weevils in the field, but fortunately the injury there is comparatively slight, and it is only after the seed has been gathered and stored that the real damage is done. To prevent this the beans should be kept in airtight containers, and should be fumigated whenever weevil injury is apparent.

OTHER BEAN PESTS.

Insects of minor importance that attack the bean are: aphids (see General Feeders, page 269); plant bugs, *Euschistus bifibulus* and *Piezodorus guildingi* (see Tomato, page 310); *Ecpantheria eridanus* (see Celery, page 285); flea-beetles (see General Feeders, page 271); grasshoppers, *Schistocera columbina*, *Pleetrotettix gregarius*, etc. (see General Feeders, page 272); *Laphygma frugiperda* which bores into the pods (see Corn, page 288); leaf-hoppers (see General Feeders, page 272); red spider, *Tetranychus* sp. (see Green Peas, page 304); and thrips, page 305.

BEETS.

THE SOUTHERN BEET WEBWORM (*Pachyzancla bipunctalis*).

This is a very common and abundant webworm on beets, chard, and weeds of the genus *Amaranthus*. It does considerable damage to the beet, skeletonizing the leaves where it webs them together to form a feeding shelter.

The adult is a small, glistening, yellowish-brown moth with a few faint, transverse, wavy, dark lines across the wings. It deposits four or five small, flat, over-lapping, scale-like eggs on a leaf at one time. These hatch into small, yellowish larvæ that feed on the leaves for about ten days before changing to pupæ and then to adults.

Control.—The larvæ may be readily controlled by spraying the plants with arsenate of lead, three pounds in fifty gallons of water, or by dusting them with a mixture of equal parts of arsenate of lead and hydrated or air-sladed lime.

THE SMALL BEET WEBWORM (*Zinckenia fascialis*).

The larvæ of this moth occur frequently along with those of the preceding species, and although not so abundant, do the same kind of damage, the webbing and skeletonizing of the leaves.

The larva of this species looks very similar to that of the preceding species, but the adult is dark brown in color, with transverse white bands across the wings.

Control.—Methods of control are the same as for the preceding species.

OTHER BEET PESTS.

Other insects attacking beets are: *Nacoleia indicata* (see Beans, page 275); *Systena basalis* (see Carrots, page 284); *Xylomeges sunia* (see Chard, page 287); leaf-hoppers (see General Feeders, page 272).

CABBAGE.

THE DIAMOND-BACK MOTH (*Plutella maculipennis*).

This minute moth is undoubtedly the worst insect pest of cabbages in Porto Rico. The small green caterpillers or worms occur in large numbers on the undersides of the leaves, riddling them with holes. These holes do not extend completely through the leaves, so that the leaves have a skeletonized appearance and when blown by the wind they crackle like paper.

This pest is at its worst during the summer months and unless effective measures are used to control it, it is impossible to raise good cabbages.

When full grown, the small caterpillars spin loose silky cocoons on the undersides of the leaves in which they pupate. The adult is a very small grayish moth with patches of white along the borders of the front wings. When the wings are folded, these white areas form the diamond-shaped markings that give the moth its name.

Control.—The leaves of the cabbage should be sprayed on the undersides with arsenate of lead three pounds to fifty gallons of water. A sticker should be added to this spray as the leaves of the cabbage are covered with a waxy secretion. For formula see page 267. If the worms have become abundant before being discovered, the cabbages should be sprayed with a kerosene emulsion spray diluted one to fifteen. For directions for making the emulsion see page 268.

THE SOUTHERN CABBAGE BUTTERFLY (*Pontia monuste*).

This butterfly is usually to be seen flying about patches of cabbages and other cruciferous plants. It deposits clusters of bright yellow eggs on the upper surface of the leaves, and these soon hatch into hairy greenish-yellow caterpillars.

FIG. 36.—The Diamond-Back Moth (*Plutella maculipennis.*) A, adult moth; B, larva; C, pupa; D, mustard leaf showing injury by the larvæ. (U. S. Bureau of Entomology.)

These caterpillars feed ravenously for about two weeks and a half, when they seek a sheltered spot in which to pupate. In a short time they transform into large, handsome, white butterflies, with dark-brown markings on the margins of the wings.

This pest does not do so much damage to the cabbage as it does

FIG. 37.—The Southern White Cabbage Butterfly. (*Pontia Monuste*). Eggs and larva.

to some of the other cruciferous plants. It may be easily controlled with the arsenate-of-lead spray recommended for the preceding species.

THE CABBAGE APHIS (*Aphis brassicæ*).

This aphid or plant louse, although generally controlled by its

parasitic and predaceous enemies, occasionally becomes destructive. It appears at such times in large colonies on the cabbage leaves, sucking the plant juices and distorting the leaves.

The aphid is dusky green in color and appears in winged and wingless forms.

Control.—These lice may be easily destroyed by spraying them with a nicotine sulphate and soap solution. Directions for making this spray may be found on page 268.

OTHER CABBAGE PESTS.

Agromyza sp., mines the leaves; flea-beetles (see General Feeders, page 271); grasshoppers (see General Feeders, page 272); nematodes (see General Feeders, page 274).

FIG. 38.—The Southern White Cabbage Butterfly (*Pontia Monuste*). Male butterfly. Much enlarged. (U. S. Bureau of Entomology.)

CARROTS.

FLEA-BEETLE (*Systena basalis*).

This flea-beetle is a very general feeder on truck crops. It is very fond of the tender leaves of the carrot and may always be found feeding on it in large numbers.

The female beetle is metallic black in color, with two light spots near the tips of the wing covers, while the male is slightly smaller, and is metallic brown with two longitudinal light bands on the wing covers.

The small yellow eggs are placed in the soil near the roots of the plant, and the slender yellowish white larvæ that hatch from them feed on the tender roots. The entire life cycle covers a period of about two months.

These beetles may be effectively controlled by dusting the plants with a mixture of equal parts of arsenate of lead and hydrated or air-slacked lime or dry leached wood ashes.

FIG. 39.—Flea-Beetle (*Systena basalis*). 1, adult female; 2, eggs; 3, adult male; 4, full-grown larva; 5, pupa. All greatly enlarged.

OTHER CARROT PESTS.

Leaf-hoppers, a great many different species of Jassids, Fulgorids, and Cercopids are always to be found in great abundance feeding on the foliage of the carrot (see General Feeders, page 269).

CELERY.

WOOLY BEAR CATERPILLAR (*Ecpantheria eridanus*).

The hairy brown caterpillars of this arctiid moth do a great deal

of damage to celery by feeding on the tender stalks and leaves.

The female moth deposits several hundreds of greenish-colored eggs in a single mass. These hatch in about a week and the young larvæ swarm over the surrounding foliage. Needless to say such large numbers of these caterpillars do a great deal of damage before they finally pupate and turn into moths some two months later.

The adult moths are large, handsome creatures, with white wings marked with numerous small, dark rings, and with the abdomen orange colored, marked with a few black spots.

Control.—This pest may be controlled by spraying the plants with arsenate of lead, three pounds in fifty gallons of water.

MEALY BUG (*Pseudococcus citri*).

The roots of celery often times become infested with this mealy

FIG. 40.—Wooly-Bear Caterpillar (*Ecpantheria eridanus*). Larva.

bug. So numerous do they become at times that the plants are stunted and growth is almost entirely checked.

These mealy looking insects (Fig. 41) cause damage by sucking the plant juices through their slender needle-like probosces. They multiply very rapidly, the females giving birth to hundreds of living young.

Control.—It is very difficult to control this pest, but some relief may be obtained by soaking the soil around the plants with kerosene emulsion, diluted at the rate of one part of stock to ten parts of water. Directions for making the emulsion are given on page 268.

OTHER CELERY PESTS.

Xilomeges sunia (see Chard, page 287); aphids (see Cabbage,

page 281); *Ceroplastes floridensis*, occasionally attacks celery; *Saissetia hemisphærica*, (see Eggplant, page 296); nematodes, one of the worst enemies of celery (see General Feeders, page 274).

CHARD.

Xylomeges sunia.

The caterpillar of this moth is extremely destructive to a great

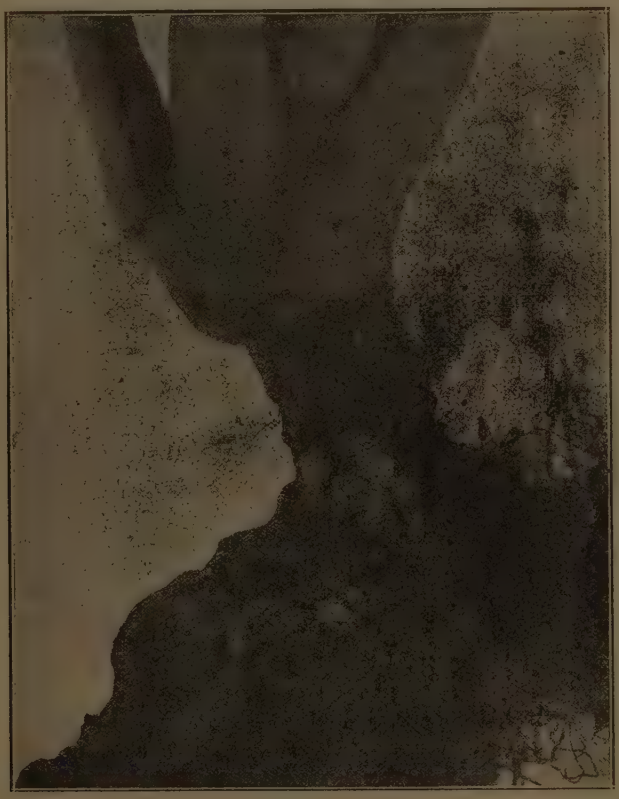

FIG. 41.—Mealy Bug (*Pseudococcus citri*) on roots of celery.

many vegetable crops, but is particularly abundant on chard.

The small, green, dome shaped eggs are laid in clusters of two or three hundred on the leaves, and are covered with a light white

fuzz. They hatch in about four days into caterpillars that when full grown are about an inch and a quarter long. They are dark gray in color, striped on the sides with a broad yellow band, and marked on the back with several velvety black patches.

These caterpillars feed voraciously on the foliage, stripping the tender young leaves to the veins and midrib. At the end of about twelve days they enter the soil to pupate, emerging nine days later as adult moths. The moth has a wing expense of about an inch and a quarter. The front wings and body are a yellowish gray, the hind wings white.

Control.—Spraying the plants with arsenate of lead, three pounds in fifty gallons of water, is an effective method of control.

OTHER CHARD INSECTS.

Pachyzancla bipunctalis does great damage by webbing the leaves (see Beets, page 280); *Zinckenia fascialis* also webs the leaves (see Beets, page 280).

CORN.

THE SOUTHERN GRASSWORM (*Laphygma frugiperda*).

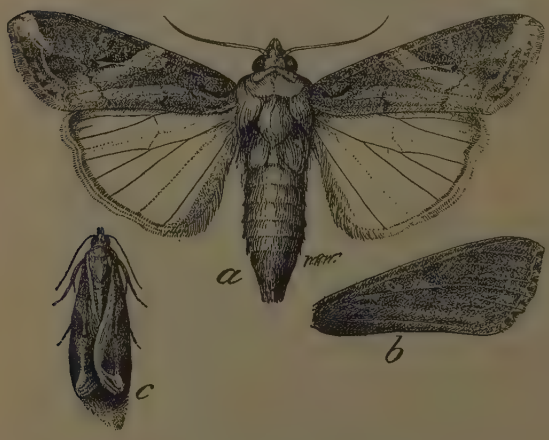

FIG. 42.—The Southern Grassworm (*Laphygma frugiperda*). Moth. (U. S. Bureau of Entomology.)

This insect, known in the United States as the fall army worm, or southern grass worm, is by far the worst insect pest of corn in this country. So abundant is it that it is almost impossible to find a field of corn that is free from it.

The very destructive larva or worm secretes itself during the day down among the rolled-up leaves of the corn, and at night feeds on the tender, young unfolding leaves. Its presence is easily detected by the chewed appearance

of the leaves, and the presence of a sawdust-like frass. It also frequently bores into the young ears of corn and destroys them.

The caterpillar when full grown is a little over an inch long. It varies greatly in color, but is usually a light brown, with a broad, wavy, yellow line along the side, and three narrow, yellow stripes along the back. The front of the head is marked with a white inverted Y which serves to distinguish it from larvæ of allied species.

The adult moth also varies considerably in color. One variety has grayish-brown front wings, and shining white hind wings, while the other variety has brownish fore wings ornamented with patches of black, yellow, and other colors, the hind wings being the same as in the first variety.

FIG. 43.—Corn Ear Worm (*Heliothis obsoleta*). Larva in sitio. (U. S. Bureau of Entomology).

This insect normally breeds on some of the native grasses, but prefers the succulent corn leaves. It is also very fond of many other vegetable plants, and is frequently found boring into the fruit of tomatoes and the green pods of the bean. When numerous, the larvæ have the habit of moving in large bodies from place to place as the food supply grows scanty, to which habit is due the common name of army worm.

Control.—The most effective way of controlling this pest is to dust the plants with a mixture of equal parts of arsenate of lead and hydrated or air-slacked lime, being careful to shake the dust well down among the folded leaves. Another method is to hand-pick the worms.

CORN EAR WORM (*Heliothis obsoleta*).

Another caterpillar that is injurious to the corn is the so-called

corn ear worm. This worm confines its attention chiefly to the ears of the corn.

The yellowish-gray moth lays its eggs usually on the silks of the ears and the young caterpillars on hatching, feed for a short while on the silks, then crawl into the ears where they stay and feed until full grown. They then eat a small hole in the side of the ear, and drop to the soil to pupate, later emerging as adult moths. When the corn is young the eggs are laid on the leaves, and the larvæ develop in the growing bud.

Control.—After the caterpillars have entered the ear it is impossible to reach them with poisons, so it is necessary to kill them before they have made their way within. This may be done by dusting the silks with the poison dust recommended for the preceding species.

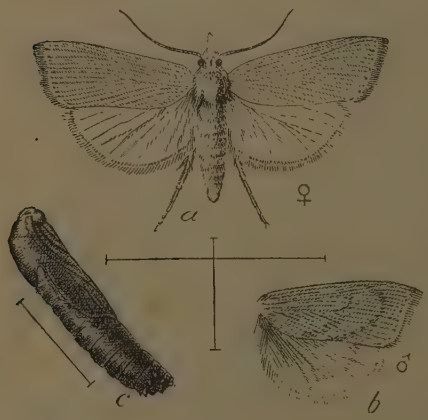

FIG. 44.—The Moth Stalk-Borer (*Diatræa saccharalis*). Moth and larva.

THE MOTH STALK-BORER (*Diatræa saccharalis*).

This destructive insect (Fig. 44), although regarded chiefly as a pest of sugar cane, is very fond of corn and causes great damage to this crop by its feeding activities.

The inconspicuous moth, which varies in color from almost white to a light, yellowish-brown, deposits batches of small, flat, white eggs on the leaves. These hatch in a few days and the young larvæ or caterpillars penetrate the stalk and tunnel through the pith, oftentimes girdling the stalk so that the plant shrivels up and dies, or so weakening it that it is snapped off by the wind. The caterpillar does not confine itself to one tunnel, but often leaves the first one it has made to start another elsewhere.

The full-grown caterpillar is about an inch long, and is a dirty white in color marked with numerous dark spots. It pupates within the burrow that it has formed, and later emerges as a moth through a small hole in the stalk that it cuts before pupating.

Control.—Little can be done to prevent damage by this insect, except to collect the egg clusters and destroy the infested stalks.

CORN LANTERN FLY (*Peregrinus maidis*).

If the base of a corn leaf is examined, the observer will usually find between the leaf sheath and the stalk, a number of peculiar looking insects that sidle quickly around the stalk or hop into the air at being thus disturbed.

These little gray insects with their delicate wings and crescent-shaped heads, are known as lantern flies. The adults are gray in color with darker markings on the wings, while the immature forms are wingless and are somewhat mealy looking. All stages of this insect feed on the plant juices of the corn, sucking it out through the needle-like proboscis. They are always present in more or less abundance, and cause considerable harm by sapping the vitality of the plants.

The adult females insert small, yellow, flask-shaped eggs into the tissue of the leaves and stems, from which hatch young wingless lantern flies. After feeding for about two weeks these finally change into the winged adults.

The amount of damage caused by this insect does not warrant the expense of any special effort to control it on a field scale. However, in a small garden patch they may be controlled by spraying with fish-oil soap solution, one pound of soap in five gallons of water. The addition of five spoonfuls of 40 per cent nicotine sulphate will materially increase the efficiency of this spray.

CORN LEAF APHIS (*Aphis maidis*).

This bluish-green plant louse is occasionally found in great numbers on the upper parts of the stalks and leaves of the corn.

When conditions are favorable, it increases in numbers with great rapidity and injures the leaves by sucking the juices and causing them to shrivel up and die.

The young or immature forms are wingless and resemble the adults which may be either winged or wingless.

Control.—So numerous are the insect enemies of this plant louse that its spread is checked soon after it appears, hence no artificial remedies are required.

CORN FEEDING SYRPHID FLY (*Toxomerus politus*).

This species is occasionally very abundant on corn and some of the native wild grasses. The yellowish colored grubs feed on the pollen grains and on the saccharine cells in the axils of the leaves.

This habit of eating the pollen, while not usually serious, might at times interfere with the pollination of the corn.

The grubs pupate between the stalk and the leaf-sheath, or on any convenient portion of the leaf, and emerge as small yellowish flies spotted and banded lightly with black.

Control.—Fortunately the parasitic enemies of this insect are so numerous that it never causes serious damage, and no artificial remedies are required.

CORN LEAF MINERS (*Agromyza parvicornis and Cerodonta dorsalis*).

The leaves of the corn are frequently mined by the larvæ or grubs of these two flies. The adult flies insert their small white eggs in the tissue of the leaf and the young grubs burrow their way towards the base of the leaves, devouring the tissue between the two leaf surfaces.

The grub of *Cerodonta dorsalis* makes a long, narrow burrow or mine and may occasionally leave the first mine and start another, but that of *Agromyza parvicornis* remains in the first mine, forming a long, narrow mine that finally spreads out into a small blotch.

FIG. 45.—Cowpea Stalk and Pod Borer (*Ballovia cistipennis*). Adult.

Control.—As in the case of the preceding species these two insects also have so many insect enemies that prey upon them that they never becomes sufficiently numerous to cause serious damage.

OTHER CORN PESTS.

Aphis sp., feeds on roots; *Diabrotica graminea*, the larvæ feed on the roots and the adults on the tassels (see Okra, page 302); *Pseudococcus* sp., on roots.

COWPEAS.

STALK AND POD BORER (*Ballovia cistipennis*).

The larva of this small moth does considerable damage at times by boring in the stalks and pods of the cowpea.

The presence of this caterpillar is indicated by a quantity of

frass exuding from the entrance hole in the stem or pod. If the stem be split lengthwise, the small dirty-white or brownish caterpillar will be discovered at the end of the burrow that it has made. The injury to the stalk usually causes the top of the plant to wither and die, while the peas in the infested pods are usually rendered worthless.

The adult is a small moth with dark-brown front wings and creamy white, shining hind wings.

Control.—Little can be done except to collect and destroy infested plants and pods.

THE VELVET BEAN CATERPILLAR (*Anticarsia gemmatilis*).

This insect which is so destructive to the velvet bean also attacks the cowpea.

The slender green caterpillars are marked with a few indistinct light lines, running lengthwise of the body, but so well do they blend with the foliage that it is very difficult to see them. When disturbed they throw themselves about violently by vigorous contortions of the body, a method of escape that is very effective.

When full grown the larva enters the soil to pupate and later emerges as a fairly large grayish-brown moth, with a dark line extending diagonally across each wing.

Control.—The caterpillars may be controlled by dusting the plants with a mixture of one part of arsenate of lead to three or four parts of hydrated or air-slacked lime or dry, leached wood ashes.

COWPEA POD WEEVIL (*Chalcodermus ebininus*).

This small black weevil may occasionally be seen feeding on the leaves and pods of the cowpea.

The female beetles lay their eggs within the seeds in the pod and the young grubs develop within the peas until they attain their full growth. They then cut their way through the side of the pods and make their way to the ground, where they pupate and later emerge as adult beetles. They never become numerous enough to cause serious damage.

OTHER COWPEA PESTS.

Cerotoma ruficornis is one of the worst pests of cowpeas. The beetles strip the leaves, and the larvæ feed on the roots (see Beans,

page 275); *Eudamus proteus* (see Beans, page 277); *Nacoleia indicata* (see Beans, page 278); weevils (see Beans, page 279).

CUCUMBERS.

THE MELON CATERPILLAR (*Diaphania hyalinita*).

Cucumber, melon, and squash vines are often seriously injured by a small, slender green worm known as the melon caterpillar. This worm or caterpillar has the habit of feeding on the foliage, and also of boring into the fruit and stalks of the vine.

After feeding for about two weeks, the caterpillar transforms to a pupa within a fold of a leaf. A few days later the adult moth emerges. It is a very handsome moth, with iridescent white wings bordered with brown.

It may be controlled by spraying the plants with arsenate of lead, three pounds in fifty gallons of water, or by dusting them with a mixture of equal parts of arsenate of lead and hydrated or air-slacked lime.

FIG. 46.—The Melon Caterpillar (*Diaphania hyalinita*). Adult Moth.

MELON APHIS (*Aphis gossypii*).

During certain seasons of the year, the leaves of the cucumber and other cucurbits will be seen to be curled up and wilting, and if they are examined it will be seen that the undersides of the leaves are covered with masses of greenish plant lice.

These winged and wingless soft-bodied insects are known as melon aphides and they increase with such rapidity that they very often ruin whole patches of vines before they are brought under control by their natural enemies. They injure the plants by sucking the vital juices. As soon as one leaf is dried up they move to another.

Control.—These plant lice may be easily controlled by spraying them with a nicotine sulphate and soap solution as recommended on page 268.

THE LARGE STRIPED CUCUMBER BEETLE (*Diabrotica innuba*).

These black and yellow striped beetles are always to be seen around cucumber, squash, and melon vines. They feed chiefly on the flowers,

which they are very fond of, but occasionally eat the tender young leaves.

The beetles lay their small yellow eggs in the soil around the roots of the plants, and the larvæ, which are slender, white, worm-like creatures, feed on and tunnel the roots.

These beetles, although always common, never become excessively abundant, probably due to the fact that cucurbits are never grown on a very large scale in Porto Rico.

Control.—When these beetles are troublesome the plants should

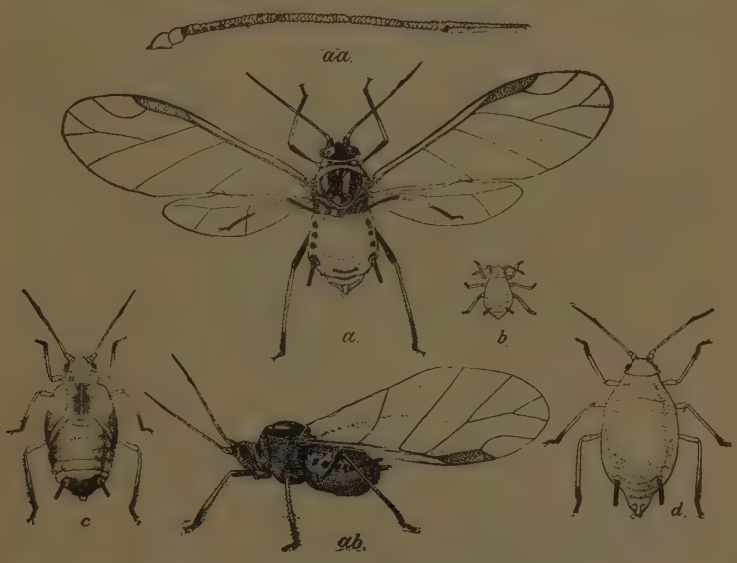

FIG. 47.—Melon Aphis (*Aphis gossypii*). *a*, winged female; *ab*, dark female; *b*, young nymph or larva; *c*, last stage of nymph; *d*, wingless female. All much enlarged. (U. S. Bureau of Entomology.)

be sprayed with arsenate of lead, three pounds in fifty gallons of water. This will repel the beetles and kill those that feed.

THE SMALL STRIPED CUCUMBER BEETLE (*Diabrotica bivittata*).

This beetle is very similiar to the preceding species except that it is smaller and its legs are entirely testaceous, whereas the legs of the larger species are partly black.

Its life history and feeding habits are very similiar to the preceding form, and it may be controlled in a similar manner.

OTHER CUCUMBER PESTS.

Ants eat out the contents of seeds (see General Feeders, page 269); *Leptoglossus gonogara* (see Squash, page 307); *Phthia picta* (see Squash, page 307); *Pycnoderes incurvus* (see Squash, page 306).

EGGPLANT.

FIG. 48.—Melon Aphis (*Aphis gossypii*). Cantaloupe leaves showing curling caused by the aphis. (U. S. Bureau of Entomology.)

FIRE ANT

(*Solenopsis geminata*).

This abundant and disagreeable ant has been occasionally found doing damage to the eggplant. It builds galleries of mud over the stem and branches and covers the fruit with a layer of soil, under which it feeds.

It may be controlled by destroying the nests that are to be found at or near the roots of the plant affected. For directions see page 269.

EGGPLANT APHIS

(*Rhopalosiphum persicæ*).

This grayish-green aphid frequently occurs in great numbers on the eggplant and peppers. Both winged and wingless forms occur on the plants at one time, and they multiply so rapidly that once started they soon infest every plant in the patch.

They feed chiefly on the undersides of the leaves, but often occur on the upper sides and on the young developing buds as well.

Control.—Spray the infested plants with a nicotine-sulphate and soap solution as recommended on page 268.

EGGPLANT LACE BUG (*Corythaica monacha*).

This insect is undoubtedly the worst insect pest of the eggplant in this country. It is a delicate little insect with gray, lace-like wings marked with brown.

It deposits small flask-shaped eggs in the tissue of the leaves,

FIG. 49.—The Large Striped Cucumber Beetle (*Diabrotica innuba*). Adult on cucumber blossom.

which hatch into small wingless nymphs. These, together with the adults, congregate in hundreds on the undersides of the leaves of the eggplant, sucking out the plant juices and causing the leaves to dry up and fall off.

The nymphs attain adult form in about ten days after hatching, a rapidity of development that allows them to increase in numbers so rapidly that unless they are controlled they may completely defoliate an entire patch.

Control.—They may be controlled with a soap and water spray, eight pounds of fish-oil soap to fifty gallons of water. Care should

be taken to spray the undersides of the leaves as it is essential to hit the lace bugs in order to kill them.

TOBACCO FLEA-BEETLE (*Epitrix parvula*).

This small brown beetle (Fig. 52) commonly occurs in large numbers on the eggplant.

In addition to the damage it causes by riddling the leaves with its feeding punctures, it is thought to spread from one plant to another a disease[1] that is very destructive to the eggplant.

FIG. 50.—Eggplant Aphis (*Rhopalosiphum persicæ*). Aphid on blossom of eggplant.

The minute oval eggs of this insect are laid in the soil around the roots, and the small threadlike white larvæ that hatch from them feed on the roots.

Control.—This beetle may be effectively controlled by dusting the plants with a mixture of equal parts of arsenate of lead and hydrated or air-slacked lime or dry, leached wood ashes.

[1] Wilt, due to *Bacterium solanacearum*.

LEAF FOLDER (*Pachyzancla periusalis*).

The larvæ of this pyralid moth fold over the edges of the leaves of the eggplant, forming a retreat in which they live and feed. They attack the plants chiefly when they are young and tender, rarely causing serious damage after the plants have attained their growth.

The moth is gray in color with a wing expanse of about three-fourths of an inch, the wings being marked with transverse, dark, wavy lines. They deposit small, flat, translucent eggs singly on the leaves which hatch in a few days into the caterpillars that do the damage.

FIG. 51.—Eggplant Lace Bug (*Corythaica monacha*). Adult.

The caterpillars when full grown are about three-fourths of an inch long, and are yellowish-white in color with light reddish-brown markings.

Control.—Spraying the plants with arsenate of lead, three pounds in fifty gallons of water or dusting them with a mixture of equal parts of arsenate of lead and hydrated or air-slacked lime, will effectively protect them from this insect.

TOBACCO SPLIT WORM

(*Phthorimæa operculella*).

The tobacco split worm, so called on account of its injury to tobacco, is the caterpillar of a small inconspicuous gray moth. It causes considerable damage by mining the leaves of the eggplant, causing them to dry up and so seriously weakening the plant.

The small oval eggs of this species are laid singly on the leaves, and the caterpillar which is greenish in color, tinged with maroon on the thorax, usually begins to tunnel the midrib of the leaf, then branches out and mines the membrane of the leaf. When disturbed the caterpillar retreats to its tunnel in the midrib.

Control.—The affected leaves should be collected and destroyed, or the caterpillars should be destroyed in the mines by pinching.

EGGPLANT LEAF MINER (*Acrocercops sanctæcrusis*).

The leaves of the eggplant are also mined by another caterpillar, a small, red caterpillar that makes a small, somewhat blotch-shaped mine and causes a peculiar puckering of the leaf around the mine. They often occur in numbers in the same leaf, and are easily distinguished from the preceding species which makes a much longer mine.

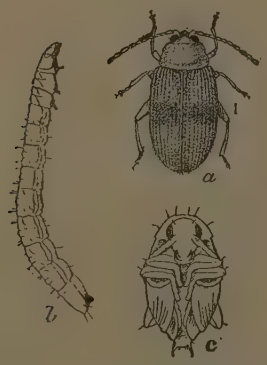

FIG. 52.—Tobacco Flea-Beetle: *a*, adult; *b*, larva; *c*, pupa. (*Epitrix parvula*). (U. S. Bureau of Entomology.)

The adult is a very small moth with brownish front-wings banded with white, and feathery, brown hind-wings.

Control.—The parasites of this insect are very abundant and keep it well under control at all times.

THE EGGPLANT STEM BORER

(*Baris torquatus*).

This weevil is a pest of both the wild and cultivated eggplant. The adult beetle, which is a small black-and-white marked weevil, feeds to some extent upon the foliage, while the grub-like larva bores in the stem and branches of the eggplant, sometimes causing its death.

The beetle lays its small, oval, white eggs in a crescentic slit in the stem and in a few days these hatch into small, white, legless grubs that begin at once to bore in the stem.

Control.—Affected branches should be collected and destroyed. The adult beetles may be hand picked.

FIG. 53.—Leaf Folder (*Pachyzancla periusalis*.) Adult.

EGGPLANT BUD WEEVIL

(*Anthonomus pulicarius*).

The eggplant is also attacked by another weevil that feeds on the leaves and breeds in the flower buds.

The eggs of this species are laid in the young developing buds, and the small white legless larvæ develop within the bud, causing it to dry up and drop off. Several grubs may develop in one flower

bud. The adult beetle is a small, dark-gray, long-snouted weevil.

Control.—The beetles should be hand picked and the affected buds gathered and destroyed.

HEMISPHERICAL SCALE (*Saissetia hemisphærica*).

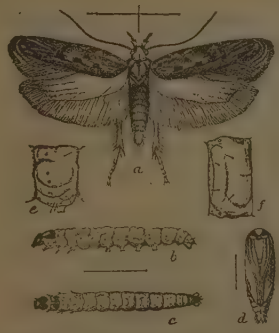

FIG. 54.—Tobacco Split Worm (*Phthomeria aperculella*). *a*, moth; *b*, larva; *c*, larva; *d*, pupa. (U. S. Bureau of Entomology.)

This brown hemispherical scale occurs on a very wide range of host plants, among which is the eggplant. It sometimes occurs in such numbers as to completely cover the stems and branches of this plant.

The insect that lives under this brown shell-like covering, sucks the juices of the plant, and when it occurs in such numbers as mentioned above, soon kills the host.

Control.—This scale may be destroyed by spraying the plants with kerosene emulsion, one part of stock solution in fifteen parts of water. Directions for making the stock solution are given on page 268.

THE WHITE SCALE (*Hemichionaspis minor*).

This small flaky white scale also attacks the stems and branches of the eggplant, but it is usually not nearly so abundant and causes far less damage than the preceding species. It may be controlled in a similiar manner.

FIG. 55.—The Eggplant Stem Borer (*Baris torquatus*). Adult beetle.

OTHER EGGPLANT INSECTS.

Changa (see General Feeders, page 270); *Diabrotica graminea,* feeds on flowers (see Okra, page 302); *Epitrix cucumeris* (see Tomatoes, page 310); grasshoppers (see General Feeders, page 272); *Laphygma frugiperda,* feeds on foliage and fruit (see Corn, page 288); *Systena basalis* (see Carrots, page 284).

LETTUCE.

Nacoleia indicata webs and feeds on the leaves (see Beans, page 278)

MELONS.

This crop is attacked by the same insects that attack the cucumber and squash.

CHINESE MUSTARD.

POD BORER.

The larva of this small moth damages the mustard by boring in the seed pods and destroying the seeds.

It is a small, slender, white caterpillar, striped on the back with five longitudinal brown lines. Head and prothoracic plate a brownish black.

The moth is a light gray in color; the front wings white, banded profusely with transverse, wavy, brownish-gray bands; hind wings white, margined with gray.

Control.—Infested seed pods should be collected and destroyed.

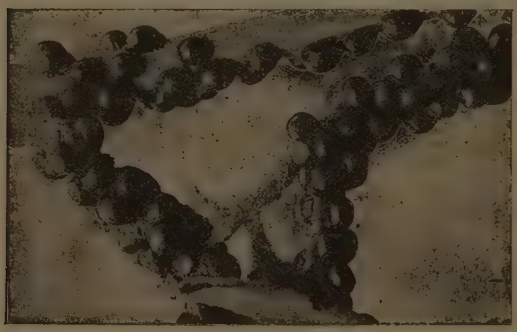

FIG. 56. — The Hemispherical Scale (*Saissetia hemisphærica*) on eggplant. (U. S. Bureau of Entomology.)

OTHER MUSTARD PESTS.

The mustard is attacked by the same insects as the cabbage (see page 281).

OKRA.

THE GREEN DIABROTICA (*Diabrotica graminea*).

This green beetle is one of the most numerous of our garden insects. It attacks almost all vegetable crops, and is particularly fond of the flowers. It is very abundant on okra, feeding on the petals, pollen, and pistil of the flowers and seriously interfering with pollination.

The beetle lays small white eggs in the soil, and the slender white larvæ feed on the roots of a number of plants.

Control.—The beetles may be controlled by spraying the plants with arsenate of lead, three pounds in fifty gallons of water.

OTHER OKRA PESTS.

Aulacaspis pentagona, the West Indian peach scale, occasionally attacks the stalks and branches; fire ant, feeds on the flowers and young growth (see Eggplant, page 296); plant lice occur on the undersides of the leaves (for control see Cabbage Plant louse, page 283).

ONION.

THE ONION THRIPS (*Thrips tabaci*).

The drying up and withering of the tips of the onion leaves, so commonly seen in onion patches, is caused chiefly by the activities of this little insect called the onion thrips.

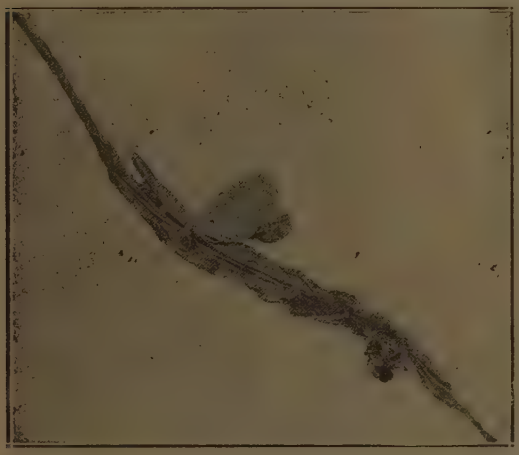

FIG. 57.—Mustard Pod Borer. Adult moth and larva on pod.

It is one of the most destructive of the vegetable-feeding thrips and attacks a wide variety of plants. The adult insect is a slender elongate little creature, about one twenty-fifth of an inch long, and is provided with two pairs of delicate wings fringed with hairs. It is pale yellow in color.

This insect causes damage by rasping or chafing the leaf surface, causing the affected portion to die and shrivel up.

The very minute eggs are inserted singly within the leaf tissue and hatch in about four days. The young are wingless and almost transparent at first, but later change to a greenish-yellow. They feed together in groups, and pass through a number of changes in form before becoming adults.

Control.—These thrips are rather difficult to control owing to the difficulty of hitting them with a spray solution. Good results may

be obtained, however, by spraying with a nicotine sulphate and soap solution as recommended on page 268, or with kerosene emulsion diluted one to fifteen.

OTHER ONION PESTS.

Laphygma frugiperda (see Corn, page 288).

FIG. 58.—The Green Diabrotica (*Diabrotica graminea*). Adult beetle on blossom of okra.

PEAS.

RED SPIDER (*Tetranychus quinquenychus*).

In dry seasons the vines of the green or garden pea are often attacked by a small red-colored mite known as red spider.

These small mites breed very rapidly, and once started soon cover a vine. In feeding they cause the leaves to turn yellow and dry up.

The adults are minute rounded creatures, provided with eight legs. They are a deep red in color.

The eggs are laid on the leaf and hatch in a few days. The young are similiar in form to the adults except that they have only six legs.

These mites are readily destroyed by spraying the plants with lime sulphur, one part in seventy-five parts of water, or by dusting the plants with flowers of sulphur diluted one-third with road dust or air-slacked lime.

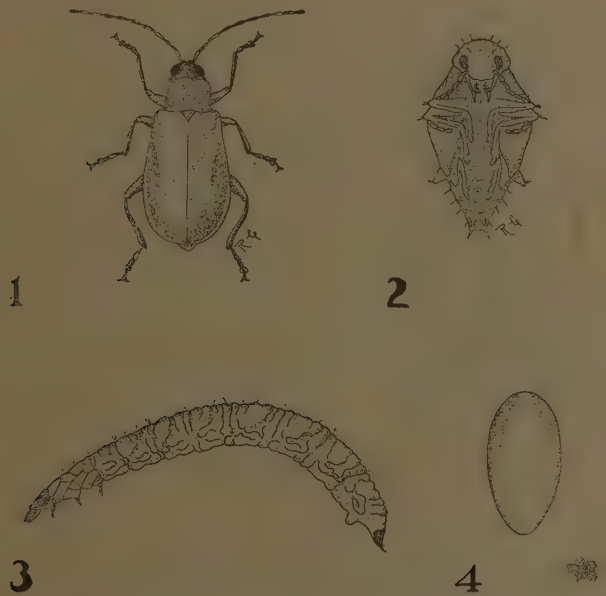

FIG. 59.—The Green Diabrotica (*Diabrotica graminea*). 1, adult; 2, pupa; 3, larva; 4, eggs.

PEA THRIPS.

These thrips, which are slender, white creatures, are often found in company with the red spiders. They cause a somewhat similiar injury. Their life history is very similiar to that of the onion thrips, and they may be controlled in a similar manner (see Onion, page 303).

OTHER PEA PESTS.

Leptoglossus gonogara sucks the juice from the pods, (see Squash,

page 307); *Nacoleia indicata* (see Beans, page 278); *Xylomeges sunia* (see Chard, page 287).

PEPPERS.

Aphis, *Rhopalosiphum persicæ* (see Eggplant, page 296); *Amphiacusta caribbea* or sick cricket, (see General Feeders, page 270); *Hemichionaspis minor* (see Eggplant, page 301); lapas (see General Feeders, page 274); *Laphygma frugiperda* (see Corn, page 288).

RADISH.

The radish is attacked by the following pests: *Pontia monuste* (see Cabbage, page 281); leaf miner, *Agromyza* sp.; flea-beetles (see General Feeders, page 269).

FIG. 60.—Small Black Squash Bug (*Pycnoderes incurvus*). Adult.

SQUASH.

SMALL BLACK SQUASH BUG

(*Pycnoderes incurvus*).

This peculiar-looking black bug feeds in all its stages on the squash and melon vines. It sucks the juice from the leaves, giving them a speckled appearance at first, but later causing them to dry up and die.

The small, translucent, flask-shaped eggs are inserted in the tissue of the stems and large veins of the leaves, and hatch in a few days into small, wingless, greenish-white nymphs. These wingless nymphs feed on the undersides of the leaves for about two weeks, growing in size and moulting five times before appearing as adults. They retain their greenish-white color until they become adults, then change to a deep black.

They may be controlled by spraying the undersides of the leaves with a nicotine-sulphate and soap solution as recommended on page

268. It is well to bear in mind that it is necessary to hit this insect with the spray in order to kill it.

LARGE SQUASH BUG (*Leptoglossus gonogara*).

This large, brownish-black bug is very commonly found with its long, needle-like proboscis inserted in the stems of the squash vine.

It lays small, brown, barrel-shaped eggs in a single row on the stems of the vine. These hatch into small, bright-red and black wingless nymphs that suck the juices from the leaves and stems in a similiar manner to the adult. These nymphs pass through a number of forms and color changes before finally becoming adults.

Control.—The best method of controlling this pest is to hand pick the adults and spray the nymphs with a nicotine sulphate and soap solution, prepared as recommended on page 268.

FIG. 61.—Large Squash Bug (*Leptoglossus gonogara*). Adult.

OTHER SQUASH PESTS.

Phthia picta (see Tomatoes, page 311). The squash is also subject to the attack of all insects that affect the cucumber (see page 294).

SWEET POTATOES.

MOTTLED TORTOISE BEETLE (*Coptocycla signifera*).

Sweet potatoes are sometimes attacked by a beautifully colored beetle called the mottled tortoise beetle. This beetle, as the name implies, is shaped somewhat like a turtle. It is black in color, and marked with six irregular golden spots.

The native food plant of this beetle is the wild morning glory, but it leaves it for the sweet potatoes, riddling the leaves with its feeding punctures. The peculiar-shaped, yellowish larvæ also feed on the leaves but do not cause nearly so much damage as do the beetles.

Control.—This pest may be controlled by spraying the plants with arsenate of lead three pounds in fifty gallons of water.

Chelymorpha argus var. *geniculata.*

The sweet potato is also attacked by another tortoise beetle. It is much larger than the preceding species, and is a brick red in color, marked with numerous black dots.

Its habits are very similiar to the preceding species, and it may be controlled by similiar means.

SWEET POTATO FLEA-BEETLE (*Chætocnema apricaria*).

This minute bronze-green flea-beetle, which usually lives on the wild morning glory, is very fond of the sweet potato foliage, and often causes injury by its feeding activities.

It may be controlled by dusting the plants with a mixture of equal parts of arsenate of lead and air-slacked lime or dry, leached wood ashes; or by spraying the plants with arsenate of lead three pounds in fifty gallons of water.

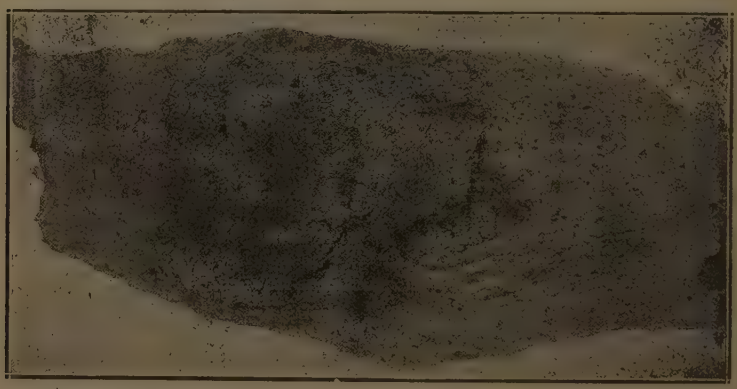

FIG. 62.—Sweet Potato Root Borer (*Cylas formicarius*). Adults on sweet potato.

THE SWEET POTATO ROOT-BORER (*Cylas formicarius*).

The sweet potato root-borer is a slender beetle about one-fourth inch long and bluish black in color, except the thorax and legs which are rufous.

The eggs are deposited in small cavities hollowed out of the stem of the potato plant. Small white grubs hatch from these and burrow

down the stalks to the roots, finally pupating and transforming to beetles at the end of the burrow.

After this first generation the beetles continue breeding in the roots, and as the complete life cycle consumes only a moth, the potatoes are soon riddled with burrows and rendered unfit for use. Owing to the practice of leaving the crop in the ground for a long period of time, a mild infestation soon spreads over the entire field.

Control.—In fighting this pest the best methods are preventive ones. Clean seed or cuttings should be used and they should not be planted in land known to have been infested with the weevil the previous year. Infested potatoes should be fed to livestock.

SWEET POTATO SCARABEE (*Euscepes batatæ*).

Another weevil that injures the sweet potato is the so-called "scarabee," a small grayish-black, snout beetle. It is somewhat similiar in habits to the preceding species, spending its entire life cycle of thirty days in or on the roots.

Control.—Control methods are the same as for the preceding species.

FIG. 63.—Sweet Potato Webworm (*Pilocrocis tripunctata*). Moth. Enlarged. (U. S. Bureau of Entomology.)

SWEET POTATO WEBWORM (*Pilocrocis tripunctata*).

The pale green larvæ of this moth feed on the sweet potato foliage, webbing the leaves together to form a shelter in which they live.

The adult moth is light yellow in color, with black and brown markings on the wings.

Control.—An arsenate of lead spray, three pounds in fifty gallons of water will effectually control this pest.

SWEET POTATO BUG (*Spartocera fusca*).

This large, dull-brown colored bug feeds in all its stages on the sweet potato. The nymphs and adults insert their beaks into the stems of the vine and suck the juice.

Control.—The adults should be hand picked, but the nymphs should be sprayed with kerosene emulsion diluted one to fifteen. Directions for making the emulsion are given on page 268.

FIG. 64.—Sweet Potato Bug (*Spartocera fusca*). Adult. Greatly enlarged. (U. S. Bureau of Entomology.)

OTHER SWEET POTATO PESTS.

Empoasca mali is at all times abundant (see Beans, page 276); *Systena basalis* (see Carrots, page 284).

TOMATO.

Epitrix cucumeris.

This little black flea-beetle, known in the United States as the potato flea-beetle, occurs very commonly on the tomato, prefering it to any of the other truck crops.

It injures the plant by riddling the leaves with its feeding punctures, and in addition is thought to spread a serious disease[1] of the tomato.

The small, white eggs are laid in the soil, and the minute thread-like larvæ feed on the roots. The entire life cycle is completed in about a month and a half.

Control.—The beetles may be successfully controlled by dusting the plants with a mixture of equal parts of arsenate of lead and air-slacked lime or dry, leached wood ashes.

THE HORNWORM (*Phlegethontius sexta*).

The larva of this sphinx moth is easily recognized by its large

[1] Wilt (*Bacterium solanacearum*).

size and peculiar horn-like process at the end of the body. It is a voracious eater, consuming enormous quantities of foliage.

The adult moth is a large heavy-bodied insect, with a wing expanse of about four inches. Its wings are a dull, dark, brownish-gray, while the segments of the abdomen are strikingly marked with yellow.

The moths begin to fly at dusk, feeding on the nectar of the flowers, and laying large greenish eggs singly on the foliage of the tomato and other food plants.

The eggs hatch in a few days into small, green caterpillars, that feed and develop until when full grown they are three or four inches long. They are green in color, with white stripes along the sides.

Control.—Both eggs and larvæ are rather heavily parasitized, so the larvæ never become very numerous. They may usually be controlled by hand picking, but if too numerous for that an application of arsenate of lead three pounds in fifty gallons of water is very effective.

FIG. 65. — Potato Flea Beetle (*Epitrix cucumeris*). Adult beetle. (U. S. Bureau of Entomology.)

TOMATO PLUSIA (*Plusia rogationis*).

This is another caterpillar that feeds on the foliage of the tomato. It is about an inch and a quarter in length and is green in color, with a few longitudinal white stripes on the body. It is called a looper, from its peculiar method of locomotion, drawing the body up into a loop like a measuring worm each time it moves forward.

It develops rapidly and when full grown spins a silken cocoon in which it pupates. The adult moth is dark brown in color with two striking silvery spots in the middle of each front wing.

Control.—The larva is very heavily parasitized by a small hymenopteron, which keeps it so well under control that it seldom does serious damage. When numerous it may be controlled by spraying the plants with arsenate of lead three pounds in fifty gallons of water.

PLANT BUG (*Phthia picta*).

This large, dark-brown plant bug delights to sink its needle-like beak into the fruit of the tomato and suck the juices. The bright-red, wingless young congregate in groups on the developing fruit and distort it with their feeding punctures.

Control.—The best method of controlling this pest is to hand pick the adults and spray the nymphs with a soap and nicotine sulphate solution, prepared as recommended on page 268.

STINK BUGS.

A number of these so-called stink bugs are commonly found attacking the tomato vines. They are robust shield-shaped insects with sucking mouth parts, and are usually very inconspicuously colored. *Nezara viridula, Arvelius albopunctatus* and *Euschistus bifibulus* are the commonest of these.

Fig. 66.—Plant Bug (*Phthia picta*). Adult male. Much enlarged. (U. S. Bureau of Entomology.)

While always to be found they are never numerous enough to cause serious damage, and control measures are not needed.

THE SUCK FLY

(*Dicyphus prasinus*).

The tomato is occasionally attacked by this slender bug, which injures the plant by sucking the juices from the stems and leaves.

This suck fly is pale green in color, and may be distinguished from allied species by the large fuscous spot that is present near the margin of each wingcover, midway between the base and apex.

The minute and inconspicuous flask-shaped eggs are inserted singly within the midrib of the leaf. The yellowish-green, wingless nymphs that emerge from the eggs suck the juices from the plants in the same manner as the adults. They pass through five nymphal stages before attaining adult form.

Control.—The nicotine sulphate and soap solution prepared as recommended on page 268, is effective in controlling this insect.

TOMATO FRUIT FLY.

This Anthomyid fly lays its small, white eggs in clusters on the fruit of the tomato. At times it is very abundant and deposits eggs on about fifty per cent of the fruit.

If the fruit is sound the small, white grubs that hatch from the eggs cannot gain entrance, but if there is the slightest wound or crack in the skin they penetrate to the soft pulpy interior, causing it to decay by their feeding activities.

Control.—All craked or decaying fruit should be collected and destroyed.

FIG. 67.—The Suck Fly (*Dicyphus prasinus*). Adult. Much enlarged.

OTHER TOMATO INSECTS.

Laphygma frugiperda, larva burrows in fruit (see Corn, page 288); *Leptoglossus gonogara* (see Squash, page 307); nematodes (see General Feeders, page 274); *Systena basalis* (see Carrots, page 284); *Xylomeges sunia,* defoliates plants (see Chard, page 287.

TURNIP.

The turnip is attacked by the same insects as the cabbage (see page 281).

YAUTIA.

THE LACE BUG (*Corythuca gossypii*).

This delicate little insect with its lacy white wings breeds in colonies on the undersides of the leaves of the *yautía.* The nymphs and adults feed by inserting their beaks into the tissue and sucking the juices. This causes the leaves to turn yellow and die.

Control.—Spray the undersides of the leaves with a nicotine sulphate and soap spray, prepared as recommended on page 268.

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[1] A general volume index has been considered unnecessary, each of the longer papers constituting the volume having been provided with one.

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